M E ANALYSIS OF THE IMPORTANCE OF EACH SECTION IN ROUTINE THROUGH GREY RELATIONAL GRADE IN THE PLAYING TIME-DISTRIBUTION AND SCORES FOR ASIAN GAMES' WUSHU-CHANG-QUAN

Chih-Ming Lee, Chung-Yu Chen', Ren-Ping Tang, and Yu-Ping Lin
Chinese Culture University, Taipei, Taiwan
'National Taiwan Normal University, Taipei, Taiwan

The playing time of Wushu-Chang-Quan required routine cannot be less than 1'20". This research had the score as the grey information, and the playing time of each section as the white information, to realise the relational series between the time distribution of each section and score through grey relational analysis. Contents of the required routine are the same and playing times are similar, so the relation between time and score could be the relation between section and score. The research analysed Wushu-Chang-Quan event in '96 and '97 Taiwan's Games. The reliability of judge's scores was established through the Kendall coefficient of concordance ($p<.01$). Through the Grey Relation Model. it is found: The greater the quantity and variety in structure and arrangement in the section, the more the section influences the score.

KEY WORDS: Wushu, grey system, relational grade, routine, time distribution,

INTRODUCTION: Wushu event is separated into two categories -- free fighting and required routine demonstration. Routine contest is divided into Chang-Quan, Nan-Quan and Tai-Chi Chuan. Chang-Quan with Long and Short Weapons named as Three-Event is the most popular. The contents of Wushu judgement are movements (objective), power-coordination, spirit-rhythm-character (subjective) and other errors. There are 4 paragraphs, 10 sections and 62 movements in the Chang-Quan required routine. The playing time cannot be less than 1'20". Athletes have time and sections as the training device (National Physical College Context Committee, 1990). To prevent deductions from less than 1'20" and to avoid loss of rhythm and character by exceeding 1'20", good athletes always keep playing time to 1'20" to have the best performance. Most athletes play the front half-routine fast to keeping more time to perform the late half smoothly. This strategy is not good for rhythm and character, particularly for athletes with poor physical fitness, as they become exhausted in the late half and this influences the performance. So, realising the importance of each section could change athletes' time distribution to sections of routine to control physical fitness and improve score.

The description of the grey system is the following: A message is structured by two elements – unmeasurable quality elements and measurable quantity elements. The system offers such a message -- some qualities but some still unknown, the area of quantities but the exact quantities still uncertain, so messages from the system are 'grey'. The main points of grey system are discussing the relationships of grey messages in the system and their measurements (Shih et al., 1994; Shen, 1996). This research had the score from judges as the grey information, and athlete's playing time of each section as the white information, to realise the relation series between the time distribution of each section and score through grey relational analysis. Movement is the variety of time and space, and routine is the performance of movements and time. The contents of the required routine are the same and the playing times are similar among 1'20", so the relation between time and score could be the relation between section and score. In the other words, the importance of each section could be known from the relation between the time distribution of each section and score. Furthermore, the relationships between movement structure and score could be realised by analysing the structure of each section.

METHODS: This research analysed the performances of male and female athletes in Wushu-Chang-Quan contest, '96 and '97 Taiwan's Games by viewing videotape. The sample rate of camcorder was 30Hz. The playing time of each section was analysed by GVR-S950

video editor. Athletes in Taiwan's Games represent each city and county, so the researchers assumed that athletes' performances were higher than the average, and did not have the other errors, and the main elements influencing score were power-coordination and spirit-rhythm-character. There are desired-score and final score in Wushu. The desired-score was used for it was not influenced by another errors from chief-judge's deduction. To test the inter-judge reliability of the five judges in each year the Kendall coefficient of concordance was used ($p<.001$).

According to the similarity between curves, relational analysis of grey system could judge their relation, compare and calculate the pattern of each element in the system (Shih et al., 1994). Before the calculation of relation, the scores of athletes and the playing time of each section should be managed through averaging to make the data into the purified unit (Deng et al., 1996). This was to prevent the difference between units of the sequences of score and playing time influencing the results of comparison and analysis.

As calculating the relation, it was presumed athletes' scores were reference sequence set x_0, and playing time of each section was compared sequence set x_i (i = 1, 2, ... , 10).

where $x_0 = \{ x_0(1), x_0(2), \ldots, x_0(n) \}$

$x_i = \{ x_i(1), x_i(2), \ldots, x_i(n) \}$ □ i = 1, 2, ... , 10 (n was the number of athletes)

So, the relational coefficients of curve x_0 and x_i on k point were expressed as

$$\xi_{0i}(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}$$

(Zhao and Tang, 1998; Lu et al., 1998)

where □$x_0(k)$ - $x_i(k)$□=□$\Delta_i(k)$ was the absolute difference of x_0 and x_i of k point

$\min_i \min_k |x_0(k) - x_i(k)|$ was two-grade min difference□

$\min_k |x_0(k) - x_i(k)|$ was the 1st grade min difference, the min difference between each point of curve x_i and curve x_0.

$\min_i \min_k |x_0(k) - x_i(k)| = \min_i \{ \min_k |x_0(k) - x_i(k)| \}$ was the 2nd grade min difference, the min difference of curve i = 1, 2, ... , 10 in min difference of each curve.

$\max_i \max_k |x_0(k) - x_i(k)|$ was two-grade max difference, which had the same meaning as min difference.

□ was distinguishing coefficient. When the value of two-grade max difference was too large, it would influence the reality of relational coefficient. □ was used to weaken the value of two-grade max difference and to promote the obvious difference between relational coefficients. This research assumed □= 0.5.

In order to quantify the relational coefficient of each point to obtain the grey relational grade r_i of the whole curve x_i and reference curve x_0, the relational coefficient of the two curves in each time should be average-quantified (Yin et al., 1998). Its calculating function was

$$r_i = \frac{1}{n} \sum_{k=1}^{n} \xi_i(k)$$

The value of each element's relational grade in relational analysis was not important, but the relational sequences between curves were the key point for question analysis. So, the relational sequences were determined by relational grade. It means that the bigger the relational grade is, the larger the playing time of the section influences the score.

RESULTS AND DISCUSSION: The Kendall coefficient of concordance and critical value of

the five judges in each year are shown in Table 1. The coordination of the scores of the five judges had significant ($p < .01$) (W value). It means there was coordination in the scores of the five judges, so the four groups' score sequences could be as reference sequences for grey relational analysis.

Table 1 The Kendall Coefficient of Concordance (W) of the Five Wushu-Chang-Quan Judges in '96, '97 Taiwan's Games

Year	Section	W	$x^2=k(n-1)W$	Critical value
'96 (k=5)	Male (n=14)	0.94'	61.37	27.69
	Female (n=16)	0.77'	57.38	30.58
'97 (k=5)	Male (n=19)	0.81'	72.77	34.81
	Female (n=17)	0.88'	70.59	32.00

*p<.01

Managing the desired score of athletes and time distribution of each section through averaging to make the data into the purified unit, these reference sequences and compared sequences could be put into the grey relational analysis function to calculate the relation. Relation could directly present the relation between each compared sequence and reference sequences (Shen and Ch'i-Pin, 1996). Table 2 indicates the relation series between time distribution of 10 sections and score of athletes.

Table 2 The Relation Series between Time Distribution of Each Section and Score (The less of the value of the number is, the larger the relation with the score)

		'96 Taiwan's Games		'97 Taiwan's Games	
paragraph	section	male	female	male	female
	x_1	10	10	10	7
	x_2	9	8	7	9
	x_3	8	9	8	3
1	x_4	6	7	9	10
	x_5	7	3	2	6
	x_6	2	6	4	4
2	x_7	5	5	5	8
3	x_8	1	1	6	1
	x_9	3	2	1	2
4	x_{10}	4	4	3	5

From table 2, the relation between time distribution of each section and score could be known. It also indicated the influence of each section on score. Comparing these phenomena with the routes of each sections (figure 1) and their movement structures, it was found that: Section 1, 2, 3, 4 had less movements, short routes, less variety of movement structure and were at the beginning of routine so had the least influence on the score. Section 8 presented 'S' pattern route through the court and had more and complex movements, so had the highest influence. Section 7 had long route and more movements but no variety. Thus, it did not have much influence on the score. Sections 9 and 10 had short, straight route and less movement but with varied movements and were at the ending of

routine so they were more important.

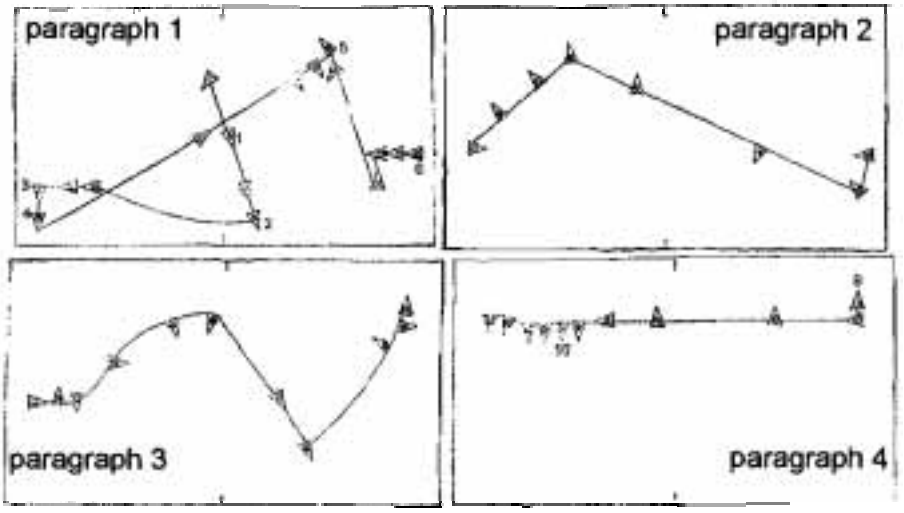

Figure 1- Movements' route of Wushu-Chang-Quan required routine. (Pang et al., 1989)

CONCLUSION: Through the Grey Relation Model, it is found: The greater the quantity and variety in structure and arrangement in the section, the more influence the section has on the score. This research applied grey relational analysis to get the relation between time distribution of each section in Wushu-Chang-Quan required routine and score. It not only could find the relation between sections and score offering athletes and coaches as training directions, but also could find that subjective spirit-rhythm-character judgement is influenced by movement structure and route on the court. As Wushu event would develop the contest of self-edit routine, this result could offer the direction to edit routines.

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